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| <b>(54) Title: DEVICE FOR THE OPERATION OF APPLIANCES, UTILITIES AND SERVICES WITHIN A BUILDING</b>   |  |   |   |
| <b>(57) Abstract</b><br><br>A device (2) for installation in a building for the operation of appliances, utilities and services within the building, the device (2) being capable of connection to a plurality of communications media (represented by their means of receipt 21-25) via interface circuits (11-17), with microcontroller and associated circuitry (7) on a core platform (3) together with memory and associated software (30). The microcontroller (7), connected to a remote master microprocessor via the communications media, can act on information and instructions received from or via the master microprocessor, provided program protocols, already programmed into the software (30), are matched by protocols sent with the information and instructions. The device (2) is connected via appropriate interface circuitry to electrical and electronic circuitry in appliances within the building, which appliances can then be controlled either remotely or by a user input means (8). |  |   |   |

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**TITLE: DEVICE FOR THE OPERATION OF APPLIANCES, UTILITIES AND SERVICES  
WITHIN A BUILDING**

**Technical Field**

5           The present invention relates to a device and method for the control and  
operation of appliances, utilities and services within a building. More particularly the  
present invention provides for such control and operation through one or more means  
of signal input to a building and output from a building. The present invention  
additionally provides a means whereby one or more providers of services and goods  
may supply information and goods directly to a building or offer a range of information  
10       for use within the building.

**Background Art**

          At present there is a limited ability to control appliances within a building, or  
dwelling, from a distance. Remote control and monitoring of one or more different  
utilities has also been limited in scope.

15           US Patent No 4847782 (Brown) discloses an energy management system  
which provides signals to a plurality of subscriber units over alternative links (for  
example, cable television, telephone, radio). A transponder in each unit responds to the  
signals by providing corresponding signals on the in-house electricity network. However  
communications links are not used in parallel.

20           US Patent No. 44442319 (Treidl) discloses a central control means for  
controlling electrical apparatus via an in-house electricity network/ Control is in the form  
of timed on/off commands which can be changed remotely via telephone. There is no  
disclosure of multiple links and multiple accessibility.

25           US Patent No. 4602340 (Appelburg) discloses a system for distributing  
information control and monitoring systems within a building. However there is not open  
accessibility and no multiple means of communication.

30           Also it has not been possible for a building owner to select quickly and easily  
from a range of suppliers of one type of utility. It has also not been possible for a utility  
supplier to advise a purchaser or client of changes in price structures that the purchaser  
may take immediate and also instant advantage of, via the supply conduit or other than  
by conventional postal (etc) means. There is little ability for a customer to tailor use of  
a utility to take advantage of altered rates of supply, to their advantage.

          Use of a power line as a carrier for pricing information is available, but there  
is limited ability for the end user to fully utilise this information or the changes in this

information without constant monitoring and manual input of some aspect of the change from one pricing structure to another.

Devices are apparently being trialed for allowing the use of a television for interactive use. However, this at present requires connection to both a phone line and a power line. Home computers have been used for some of the above operations, but remote control must be via a phone line (modem). Wireless control has been published as being possible as a communication avenue. "Smart" phones, including a microcontroller, are available for a limited amount of home remote shopping; on a trial basis.

All these known or proposed systems require either a special cable connection to the dwelling, a power connection, and also a closed proprietary access for the service or goods provider to the customer. All address one aspect of the environment and activities occurring within a building.

An object of the present invention is the provision of an open access system (in the sense of being non-proprietary, but is secure at the end use point)-incorporating a microcontroller, for delivery of a plurality of types of information and orders for the operation of equipment and appliances within or about the building and for other uses; the delivery means of such information and instructions being possible by two or more alternative means (or split between two or more means) of delivery to the building and one said delivery means being capable of being independent of the supply of power to a building.

A further object of the invention is the provision of such a system whereby no additional cabling or lines are needed with a building or to a building for the implementation of the invention.

#### Summary of the Invention

The present invention provides a device for installation in a building said device being capable of connection to a plurality of communications media, wherein said device includes:

a microcontroller means;

memory means;

software instructions;

one or more interface circuits each of which allows connection to a communications medium; wherein

said device is capable of receiving and sending control instructions and

information via one or more of said communications media such that said device can control, monitor and/or operate electrical and electronic circuitry within and about said building and return instructions and information via one or more communications media; and

5           said control instructions are based in said software instructions and on remote information and remote instructions received by said circuitry; and

          said remote information and remote instructions are receivable only from a user input means and from one or more master microprocessors means which are remote from said building.

10           Preferably said communications media include at least one of the following: power lines to said building; telecommunications lines to said building; other cable lines means (for example, co-axial cables, fibre optic cables); broadcast signals on the electromagnetic spectrum (for example, infra-red, broadcast signals capable of receipt by a television aerial or satellite receiving dish, wireless transmission, FM signals); or  
15           any combinations thereof.

          Preferably at least one communication medium is cabling to an interactive appliance (user input means).

          Preferably instructions and information transmitted to the microcontroller are capable of being forwarded by two separate means, especially if the transmission is a  
20           vital one, for example information may be forwarded in an encoded form via a power line carrier and the decryption key forwarded by broadcast signal receivable (for example) by a television aerial on said building.

          Preferably the end user means is one that only the end user has control of (for example it is encoded in a manner like the use of a personal identification number for use with automatic teller machines) and may be selected from the following:  
25           alphanumeric key pad (for example, forming part of the security system of a building); numeric keypad; home computer; interactive television set; remote directions via a modem; or any combination thereof.

          Preferably the information and instructions transmitted to said microcontroller  
30           may be selected from a plurality of sources, for example a variety of utilities may provide information and user options, retailers of goods and services may provide information and remote buying access, appliances within the building may be remotely controlled, based on pre-determined constraints as to their operation, alternatively energy use may be stopped and started based on pre-determined constraints; remote meter reading of

one or more utilities may be effected; or any combination thereof either singly or simultaneously.

The present invention further provides a method for enabling, controlling and/or monitoring the remote control of electrical and electronic circuitry in and about a building and for enabling and controlling information flow into and out of said building, said method including the steps of:

providing the device as claimed in any one of the preceding claims installed in said building;

providing programming instructions for said microcontroller and said master microprocessor such that said microcontroller operates on instructions contained therein and received only from said master microprocessor or from said user input means, said instructions for said master microprocessor including instructions to always forward a protocol with communicated instructions;

providing said device with instructions and information on protocols against which all incoming instructions and protocols are to be checked prior to the device acting in accordance with the incoming instructions; and

wherein any information and instructions forwarded by said master microprocessor to said microcontroller may be receivable from any source provided that any protocols received with said instructions are compatible with those held in said device and said master microcontroller.

#### Brief Description of the Invention

By way of example only, a preferred embodiment of the present invention is described in detail with reference to the accompanying drawings, in which:-

Fig. 1 shows a schematic layout of a preferred embodiment of the present invention;

Fig. 2 shows the physical layout of a preferred embodiment of the present invention;

Fig. 3 shows a schematic layout of the software architecture of a preferred embodiment of the present invention.

#### Mode for Carrying out the Invention

Referring to Fig. 1, a servicing device 2 is there shown and is connected to a number of appliances or communications pathways, each of which utilise a different communications format or media.

The above described servicing device 2, appliances and systems are those

located in or about a building and on the premises of the end user. Such a building is, for example, a domestic house.

5 The servicing device 2 principally consists of a core platform 3 which comprises a microcontroller and associated circuitry 7 together with memory and associated software 30, and which is connected to a plurality of media pathways via media specific interfaces.

10 The servicing device 2 effectively forms a communications switchboard with which the following apparatus or systems of communication may interact, either with one another or with applications contained within the memory 30 of the servicing device 2: telephone lines 21; television broadcast receiver 22; power lines 23; personal computer 24; television set top box 25; hardwired in-house serial bus 26 (including: interfaces to items of electrical equipment such as electric cookers and hot water cylinders; other appliances such as security or fire detectors; and user interface panels for control of the electrical or other equipment). The servicing device 2 may also be configured to include 15 a serial bus 27 which interfaces with similar equipment to that of serial bus 26, but which utilises encoded signals on the existing in-house power network. The servicing device 2 also contains the capability to connect with other apparatus or systems of communication 28, for example radio or infra-red links and fibre optic cables. The servicing device 2 can operate using one or more of these communications pathways 20 so that it can utilise existing media such as telephone lines 21 and power lines 23 without the need for additional wiring. It can however be easily expanded later, to incorporate other pathways or apparatus such as television broadcast 22 or a personal computer 24, as they become available.

25 The servicing device 2 can be used for controlling in-house appliances such as hot water cylinders, kitchen ovens, space heaters, alarm systems (none shown) both from within or remote from the premises and includes any appliance capable of control by electrical circuitry. In it's simplest form, a servicing device 2 user terminal is in the form of one or more wall-mounted LCD display and key pad units 8 connected onto a serial bus 26 and/or 27. The or each unit 8 could be replaced or complimented with the 30 use of a personal computer 24. Examples of the way the servicing device 2 could be used include: checking from a remote personal computer 24 as to whether the oven had been turned off; switching a particular heater on prior to arriving on the premises; a security company checking the burglar alarm status of the premises; automatically switching on and off particular heaters at pre-determined times; the electric utility

signalling the servicing device 2 by the television broadcast receiver 22, in the event of a power failure, to keep heavy electrical usage items such as the hot water cylinder off, for a predetermined time after the reconnection of power.

5           The servicing device 2 is continuously operative and dedicated to the management of appliances and communications within the building. To maintain commercial viability, the servicing device 2 preferably utilised a 16 bit microcontroller 7 and 256K of RAM 30 and 256K of ROM.

10           The servicing device 2 is not restricted to the control of apparatus however, and can in addition be used as a transparent link between different media pathways. For example, an "intelligent" hot water cylinder monitor could route an electric energy pricing enquiry from a serial bus 26 or 27 through the servicing device 2 to the electric utility via the telephone lines 21. Alternatively, the electric utility might send this information periodically over one or more of the communication pathways, for example the television broadcast receiver 22 or the power line modem 23; this information could then be routed  
15           by the servicing device 2 to the hot water cylinder monitor on the serial bus 26 or 27.

          Media specific interfaces (MSIs) can include the following: a modem interface 11 for connection to the telephone lines 21; a data broadcast receiver 12 for connection to the television broadcast receiver 22; a power line carrier (PLC) modem interface 13 for connection to the power lines 23; a serial RS232 interface 14 for connection to the personal computer 24; a serial RS485 interface 15 for connection to the set top box 25;  
20           an interface programme and serial bus driver 16 for connection to the hardwired serial bus 26; a combined PLC modem and interface program 17 for the PLC serial bus 27. The servicing device 2 also has the capacity to include additional interfaces 18 to other types of media pathways such as satellite, radio or infra-red links 28. The interfaces are  
25           each designed to be compatible with the manner of data communication appropriate to each communications media.

          In practice, it has been found that a LON bus works particularly well for the above mentioned serial buses 26 and 27, and that a Microprocessor Interface Program or MIP works particularly well for the above mentioned interface programs 16 and 17.

30           Referring to Fig. 2, the circuitry for each of the above mentioned MSIs is mounted on a card (11-18) which plugs into one of the platform 3 expansion slots as shown. The servicing device 2 is thus easily expandable in response to additional communication media or appliances becoming available within the premises. The servicing device 2 circuitry is installed in an enclosure 6 which is mounted onto or within



a wall at or inside the premises. The enclosure 6 would normally remain locked in a closed position such that it is only accessible to the overall servicing device system operator, for example the local electric utility company. A battery pack 4 ensures that the servicing device 2 remains operative for some time after a power failure, which allows it to act on the power failure by, for example, alerting the electric utility company and the security company via the telephone lines 21. A connection pod 5 facilitates the physical connection of the different media types and their associated cables to the servicing device 2.

Referring to Fig. 3, a schematic of the software architecture of the servicing device 2 is shown and includes: connections to the above mentioned MSIs (11-16); a non-volatile initialisation software layer 43; random access memory (RAM) 30 which further includes: one or more communications protocol stacks (CPSs) 31-36 comparable with the number of different types of media communications to the servicing device 2; a communications link layer 40; a data base 41; a real-time operating system 42 which includes multitasking capabilities; and various application tasks 44-49. The CPSs and tasks are not limited in number to those shown.

The servicing device 2 is constrained by this software to operate in a manner which maintains the overall integrity of the system by filtering out erroneous, spurious or "illegal" communications, such that all "legal" communication conform to a defined set of protocols. This set defines the way nodes or elements within the system are addressed and messages or data transmissions are sent or received. Nodes include: devices to which the servicing device 2 is attached such as a meter reader circuit on a serial bus 26 or 27; a remote personal computer terminal of known type; areas of the servicing device 2 memory such as the data base 41 or an application task 44-49. The advantage of this system is that a node does not need to know the physical location of another node, this is transparently taken care of by the servicing device 2. The way the system is configured, for example the addressing or identifying of nodes, is controlled by the servicing device 2 so that while others can use the system, it is not possible for them to modify it except as allowed for by the servicing device 2.

A CPS (31-36) is allocated to each type of media pathway and provides a gateway between the particular data formats associated with each MSI (11-16) and the common servicing device 2 data format used by the link layer 40 for communication between the CPSs (31-36), the application tasks (44-49), the data base 41 and the real-time operating system 42. Each CPS (31-36) provides data transfer speed

conversion, data packet sequencing, error detection, destination/origin routing information and data format conversion functions such that only legitimate transmissions are allowed.

5 Nodes on different media pathways can transparently pass messages to one another or to an application task (44-49) contained within the servicing device 2 memory. They can also write data to the data base 41 in a manner constrained by the servicing device 2 and the particular task (44-49) such that while the data base 41 is open for this use (writing data), it is not possible to write data except as constrained by the servicing device 2. For example, a gas utility company may utilise a task 44 which  
10 periodically reads an electronic gas meter and stores this information in the data base 41 as constrained by task 44 and the servicing device software architecture. The utility company can then access this information via, for example, the telephone lines 21, the modem interface 11 and the CPS 31, for billing purposes.

15 Data may be downloaded onto the servicing device 2 by the servicing device system operator by any of the communications media routes available. If the data 11 is of a particularly vital or confidential nature, or may effect changes to the configuration of the servicing device 2, this transfer of data may be implemented by splitting the download over two or more media routes such that data on one media pathway decodes data from another.

20 The capacity of the servicing device 2 can be greatly extended by the use of a back office system (BOS) operated by the servicing device 2 system operator. A transparent link to this node provides the servicing device with access to far greater information and processing capacity. It also increases the communications linking capacity of the servicing device 2 by effectively providing another route to the servicing  
25 device 2 via the BOS. For example, if the telephone lines are inoperative, commands or enquiries can be routed through the BOS and onto the servicing device 2 via the power lines 23 or the television broadcast receiver 22. The BOS can also be used as an interface between the servicing device 2 and other service or information providers. In combination with the BOS, the servicing device 2 can act as a monitoring and control  
30 device for appliances; information about the status of these appliances can be processed and acted on, or passed onto other service providers via the BOS. The BOS can also provide secure communications links with the servicing device 2 and the other providers using any of the aforementioned communications media. The servicing device 2 may be used in combination with more than one BOS.

The following is a non-exhaustive list of the possible functions of the servicing device:

automatic meter reading;  
remote information access to and from other service providers;  
local appliance control;  
automatic appliance failure detection; and  
remote control in-home communication switchboard.

In this context other service providers need not be only other utility providers, but service provides in all fields, for example, banking services, etc.

5

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**CLAIMS:-**

1. A device for installation in a building, said device being capable of connection to a plurality of communications media, wherein said device includes:

5 a microcontroller means;

memory means;

software instructions;

one or more interface circuits each of which allows connection to a communications medium;

10 wherein said device is capable of receiving and sending control instructions and information via one or more of said communications media such that said device can control, monitor and/or operate electrical and electronic circuitry within and about said building and return instructions and information via one or more communications media; and

15 said control instructions are based in said software instructions and on remote information and remote instructions received by said circuitry; and

said remote information and remote instructions are receivable only from a user input means, and from one or more master microprocessors means which are remote from said building.

20 2. A device as claimed in claim 1 wherein said communications media is selected from the group consisting of: power lines to said building;

telecommunications lines to said building;

other cable lines means;

25 broadcast signals on the electromagnetic spectrum;

or any combination thereof.

30 3. A device as claimed in claim 2 wherein said broadcast signal include one or more of the following: infra-red, broadcast signals capable of receipt by a television aerial or satellite receiving dish, wireless transmission, FM signals.

4. A device as claimed in any one of the preceding claims wherein instructions and information transmitted to the microcontroller are capable of being forwarded by two separate communications media.

5. A device as claimed in claim 4 wherein said instructions and information are transmitted by one communications medium in an encrypted form and the key for decryption is transmitted by the second communication medium.

5 6. A device as claimed in any one of the preceding claims wherein said user input means is controlled by a user of said building and is controlled by a key known only to said user, said user input means being selected from the group consisting of: alphanumeric pad, numeric pad, home computer, interactive television set, remote directions via a modem, telephone;

10 or any combination thereof.

7. A device as claimed in any one of the preceding claims wherein said electrical and electronic circuitry controlled and monitored by said device includes the circuitry incorporated in appliances selected from the group consisting of: hot water cylinders, heating appliances, kitchen cooking appliances, alarm systems, lighting, televisions, computers, and any other appliance capable of control by electrical or electronic circuitry.

8. A device as claimed in any one of the preceding claims wherein said microcontroller means is a 16 bit microcontroller and the memory means includes at least 256K of RAM and at least 256K of ROM.

9. A device as claimed in any one of the preceding claims wherein said interface circuits are selected from the group consisting of: a modem interface capable of connection to a telephone line;

25 a data broadcast receiver capable of connection to a television broadcast receiver;

a power line carrier modem interface capable of connection to one or more power lines;

30 a serial interface capable of connection to a computer;

a serial interface capable of connection to a set top box;

an interface programme and serial, in-house bus driver connected to said electric and electronic circuitry;

and any combination of these.

10. A device as claimed in any one of the preceding claims wherein said device further includes a battery back up for operation of the device in the event of a power failure.

5 11. A method for enabling, controlling and/or monitoring the remote control of electrical and electronic circuitry in and about a building and for enabling and controlling information flow into and out of said building, said method including the steps of:

providing the device as claimed in any one of the preceding claims installed in said building;

10 providing programming instructions for said microcontroller and said master microprocessor such that said microcontroller operates on instructions contained therein and received only from said master microprocessor or from said user input means, said instructions for said master microprocessor including instructions to always forward a protocol with communicated instructions;

15 providing said device with instructions and information on protocols against which all incoming instructions and protocols are to be checked prior to the device acting in accordance with the incoming instructions;

and wherein any information and instructions forwarded by said master microprocessor to said microcontroller may be receivable from any source provided that  
20 any protocols received with said instructions are compatible with those held in said device and said master microcontroller.

12. A method as claimed in claim 12 wherein said programming instructions for said device include:

25 one or more program interfaces, one for each interface circuit;

A non-volatile initialisation software layer; and

random access memory which includes: one or more communications protocol stacks which are comparable with the number of different types of media communications to said device;

30 a communications link layer;

a data base;

a real-time operating system capable of multi-tasking;

and a plurality of application tasks.

**13**

13. A method as claimed in claim 12 wherein said method further includes extending the capacity of said device by the addition of a back office system which includes a link between the microcontroller and said master microprocessor means such that said real-time operating system and the plurality of application tasks can also be completed within said master microprocessor.

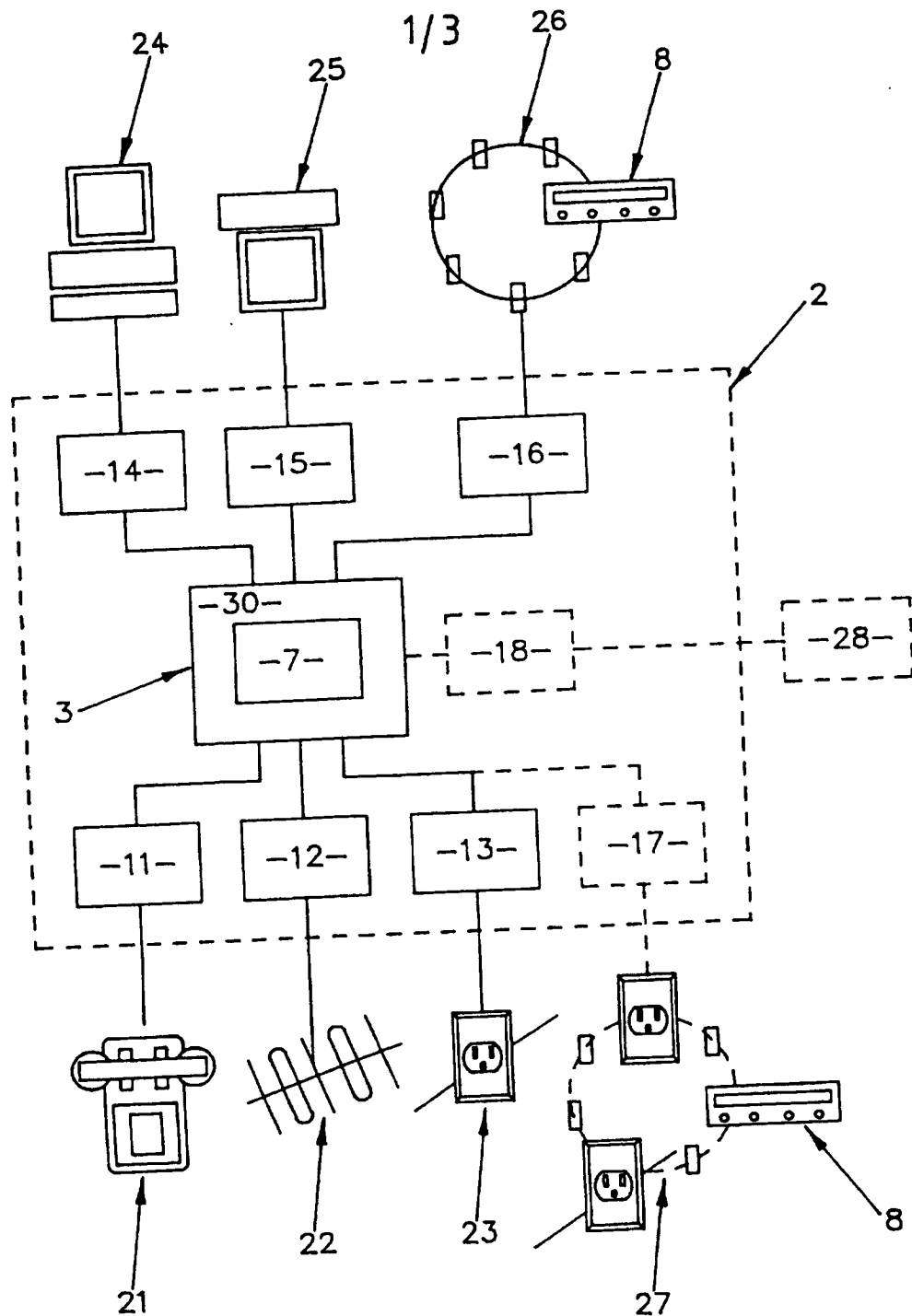


Fig. 1.



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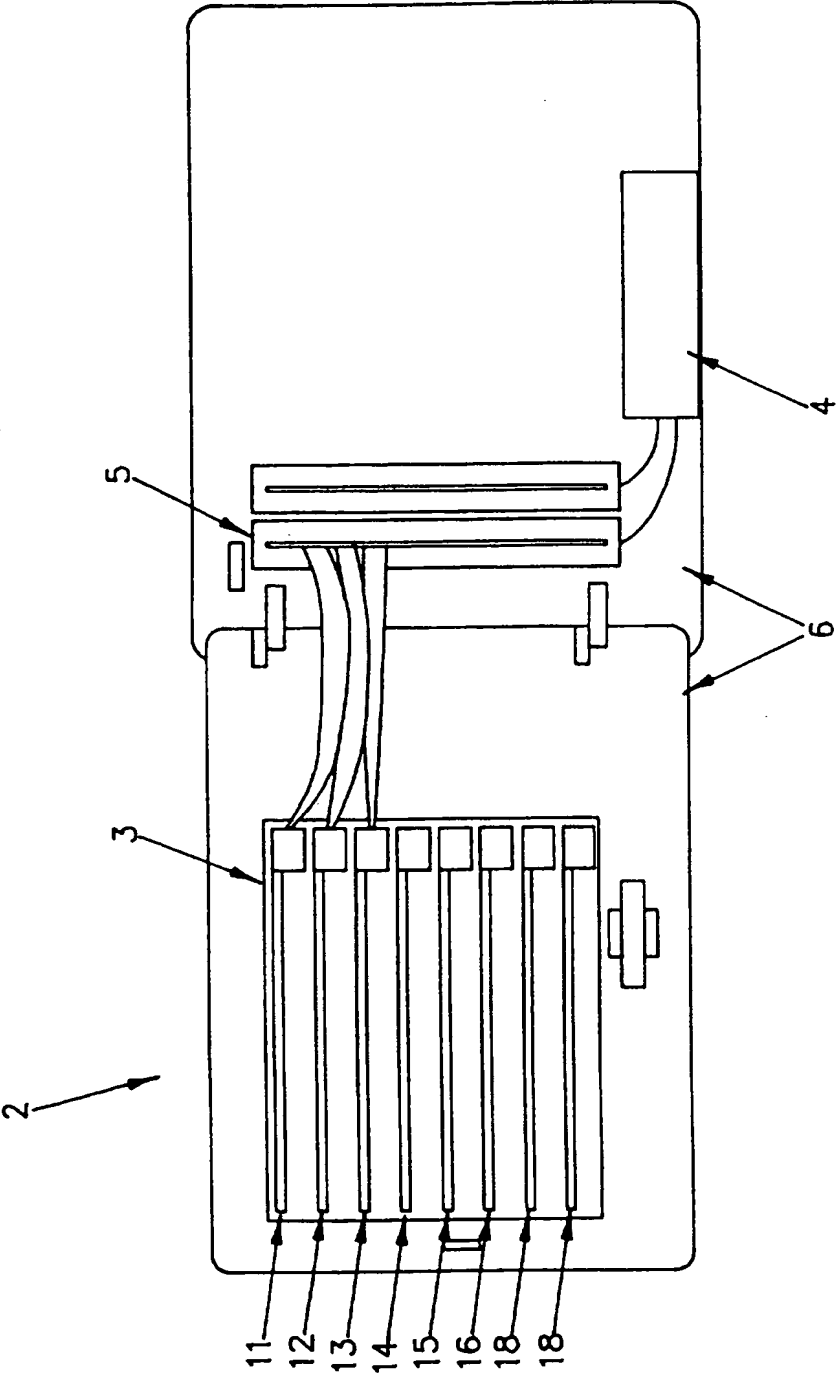


Fig.2.

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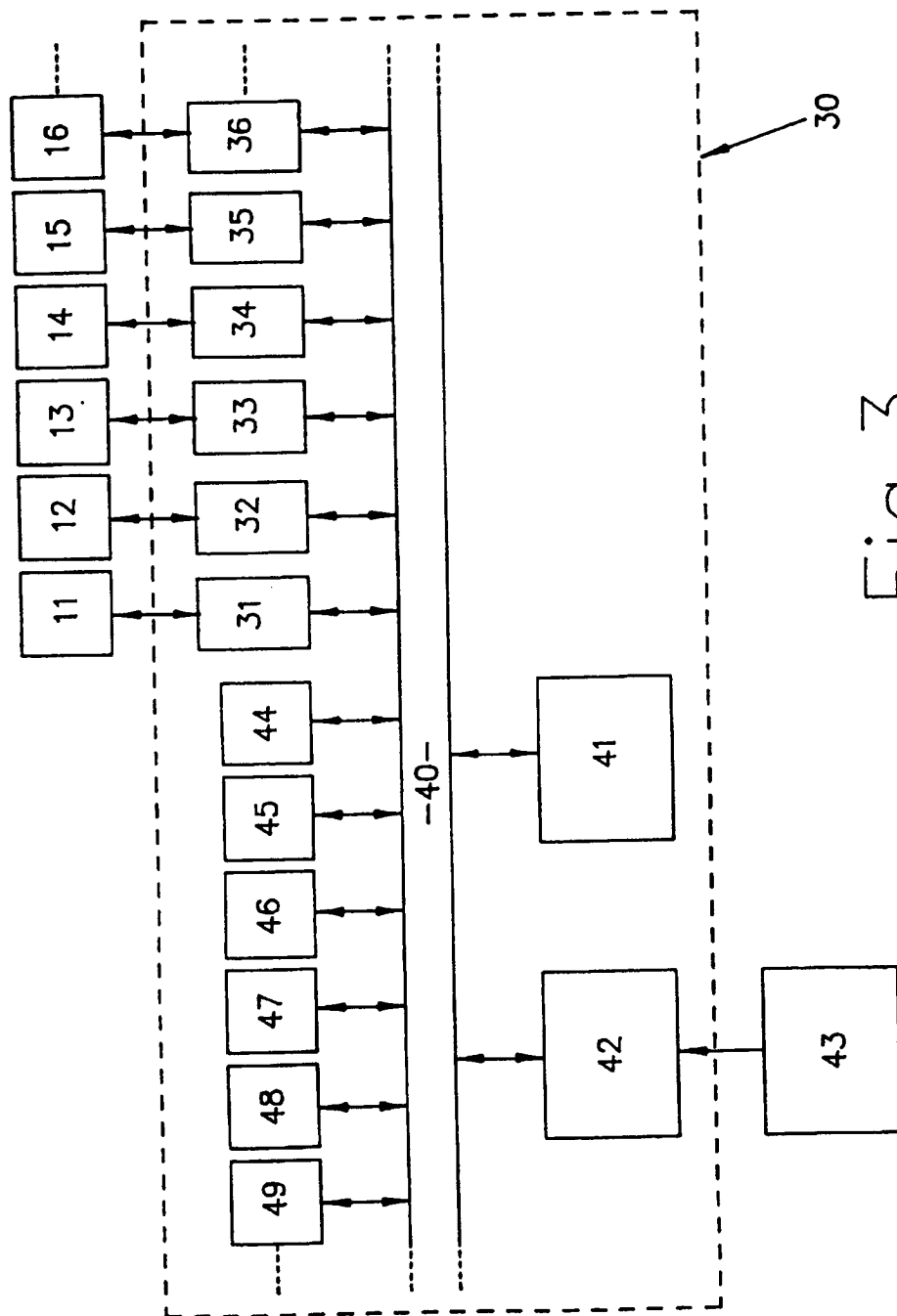


Fig. 3.

# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/NZ 96/00110

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>  |  |  |
|---|--|--|
| Int Cl <sup>6</sup> : G05D 27/02, H04M 11/00, H04B 3/54, H04Q 1/18  |  |  |
| According to International Patent Classification (IPC) or to both national classification and IPC   |  |  |
| <b>B. FIELDS SEARCHED</b>   |  |  |
| Minimum documentation searched (classification system followed by classification symbols)<br>G05D 27/02, H04M 11/00, H04B 3/54, H04Q 1/18   |  |  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>AU: IPC as above   |  |  |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>Derwent WPAT  |  |  |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>   |  |  |
| Category*   | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No.  |
| X   | DE, A, 3236812 (standard Elektrik Lorenz AG) 5 April 1984 (5.4.84) entire document | 1  |
| X   | US, A, 4206444 (ferlan) 3 June 1980 (3.6.80) entire document.                      | 1-13   |
| X   | WO 33328/95 (EDSTRÖM KOMPONENT AB) 7 December 1995 (7.12.95) entire document       | 1-13   |
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| Date of the actual completion of the international search<br>21 February 1997   |  | Date of mailing of the international search report<br>4 MARCH 1997     |
| Name and mailing address of the ISA/AU<br>AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION<br>PO BOX 200<br>WODEN ACT 2606<br>AUSTRALIA Facsimile No.: (06) 285 3929   |  | Authorized officer<br><br>R.W.J. FINZI<br>Telephone No.: (06) 283 2213 |

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